

CLAIMS

What is claimed is:

1. A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives and formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed.
2. The slurry of claim 1, being formulated for use with a fixed-abrasive polishing pad comprising at least one of aluminum dioxide, titanium dioxide, silicon dioxide, and cerium dioxide.
3. The slurry of claim 1, being formulated to oxidize copper at substantially the same rate as or at a faster rate than said tungsten is oxidized.
4. The slurry of claim 1, wherein, in said slurry, the barrier material and copper have substantially the same oxidation energies.
5. The slurry of claim 4, wherein, in said slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry.
6. The slurry of claim 1, wherein, in said slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper.
7. The slurry of claim 1, wherein, in said slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper.

8. The slurry of claim 1, wherein said slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper.

9. The slurry of claim 1, wherein said slurry comprises at least one oxidizer, at least pH control agent, and at least one inhibitor.

10. The slurry of claim 9, wherein said at least one oxidizer comprises at least one of an ammonium compound, a nitrate compound, and an amine compound.

11. The slurry of claim 9, wherein said at least one oxidizer comprises at least one of hydrogen peroxide, potassium iodate, potassium permanganate, ammonium persulfate, ammonium molybdate, ferric nitrate, nitric acid, potassium nitrate, and ammonia.

12. The slurry of claim 9, wherein said at least one oxidizer comprises about 0.1% to about 20% of the weight of said slurry.

13. The slurry of claim 9, wherein said at least one oxidizer comprises about 0.1% to about 5% of the weight of said slurry.

14. The slurry of claim 9, wherein said at least one pH control agent comprises at least one of potassium hydrogen phthalate, ammonium acetate, ammonium oxalate, ammonium carbamate, ammonium phosphate, ammonium hydrogen phosphate, ammonium dihydrogen phosphate, dibasic ammonium citrate, tribasic ammonium citrate, acetic acid, phosphoric acid, and sulfuric acid.

15. The slurry of claim 1, wherein said slurry has a pH of about 2 to about 6.

16. The slurry of claim 9, wherein said at least one inhibitor comprises at least one of an azole, an amine, and a ring compound.

17. The slurry of claim 9, wherein said at least one inhibitor comprises at least one of benzenetriazole (BTA), mercaptobenzothiazole, tolytriazole, methylamine, diethylamine, pyridine, quinoline, dicyclohexamine nitrate, potassium silicate, ammonium borate, ammonium phosphate, and potassium dichromate.

18. The slurry of claim 9, wherein said at least one inhibitor comprises about 0.05% to about 2% of the weight of said slurry.

19. The slurry of claim 9, wherein said at least one inhibitor comprises about 0.05 to about 0.2% of the weight of said slurry.

20. The slurry of claim 9, wherein said slurry further comprises at least one complexing agent comprising at least one of glycine, ammonium citrate, ammonium phosphate, and ammonium acetate.

21. The slurry of claim 20, wherein said at least one complexing agent comprises about 2% to about 15% of the weight of said slurry.

22. The slurry of claim 20, wherein said at least one complexing agent comprises about 3% to about 5% of the weight of said slurry.

23. The slurry of claim 9, wherein said slurry includes:
about 0.1% to 20% of said at least one oxidizer, by weight of said slurry; and
about 0.05% to about 2% of said at least one inhibitor, by weight of said slurry.

24. The slurry of claim 9, wherein said slurry includes:
about 0.1% to about 5% of said at least one oxidizer, by weight of said slurry; and
about 0.05% to about 0.2% of said at least one inhibitor, by weight of said slurry.

25. The slurry of claim 1, wherein said slurry removes copper at a temperature of
about 27° C. or cooler.